

## REMARKS

### Status of the Claims

Claim 1 has been amended to incorporate essentially the elements of former claims 5, 13, and 14. Claim 6 has been amended to more specifically claim the construction of the bi-prism, as shown in Fig. 2, and to depend on claim 5. Claim 18 has been amended to more specifically claim the construction of the bi-prism, as shown in Fig. 2. Claim 32, which was previously submitted in applicants' Amendment After Final dated August 6, 2007 and not entered, has been rewritten and added as new claim 33 and modified for consistency with claim 18.

In view of the amended claims, Claims 5, 7-9, and 11-14 have been canceled as redundant. Claims 1-4, 6, 10, 15-18, 20-25, and 33 are thus pending in the present application.

### Patentability of Claims 1, 2, 15, and 16

In the Office Action, Claims 1, 2, 5, 7, 11, 12, 13, 15, 16, and 26 of the present application were rejected under 35 U.S.C. § 103(a) as being unpatentable over Nelson et al. ("Nelson," U.S. Patent No. 6,750,453) in view of Sachse ("Sachse," U.S. Patent No. 6,611,329). Applicants respectfully traverse this rejection. Claims 5, 7, 11-13, and 26 have been canceled, so this rejection will be addressed with respect to claims 1, 2, 15, and 16.

Claims 1, 2, 15, and 16 are distinguished over Nelson by the recitation of detecting the presence of ethane by detecting variations in solar radiation reflected from the target area. Nelson provides his own light source as a source of radiation to be detected. The Examiner cites Sachse as teaching detecting solar radiation and concludes that it would be obvious to modify Nelson as taught by Sachse.

To expedite examination, applicants have amended claim 1 to incorporate the elements of claims 5, 13, and 14. However, it is observed that amendment of claim 1 is not necessary because Sachse teaches against the use of gas correlation cells (Col. 2, lines 38-59). Hence, Sachse teaches away from using a gas filter correlation radiometer to detect the presence of ethane by detecting variations in solar radiation reflected from a target area as claimed in claim 1.

In Sachse, an optical switching technique is used, which has the effect that, when the radiometer is moving relative to the target area, the light travelling in the optical paths 101 and 102 does not correspond to the same fields of view. The problem with this is that spatial changes in the optical features of the target area, such as a change from grass to trees, creates noise that may obscure a signal from a gas of interest.

Claim 1 distinguishes over Sachse by requiring:

traversing a target area with the gas filter correlation radiometer having the gas filter correlation radiometer field of view oriented towards the target area, the gas filter correlation radiometer being tuned to detect ethane;  
and  
sampling the corresponding pixels of the first detector and the second detector simultaneously.

Of the other references cited by the Examiner, Smith and Butler both teach time sequence processing like Sachse and thus are defective as prior art references for the same reason. Weimer is a temperature-sensing system that teaches nothing about the difficult task of detecting ethane.

Hence, claims 1, 2, 15, and 16 are believed patentable over Nelson in view of Sachse.

### Patentability of Claim 3

Claims 3 and 8 of the present application were rejected under 35 U.S.C. § 103(a) as being unpatentable over Nelson and Sachse in view of Hodgkinson. Applicants respectfully traverse this rejection. Claim 8 has been canceled, and thus its rejection is rendered moot.

Claims 3 depends from claim 1, which is distinguished over the combination of Nelson and Sachse as per the arguments given above. Hodgkinson fails to disclose the teachings that are missing from Nelson and Sachse. For this reason alone, the rejection of claim 3 should be withdrawn. In addition, the following arguments apply.

The Examiner recognizes that Nelson does not disclose the claimed bandwidth of  $2850\text{-}2975\text{cm}^{-1}$ , but cites Hodgkinson as allegedly disclosing this bandwidth in his Fig. 2. Although Fig. 2 shows a much wider band for ethane than is known in the Hitran database, what Hodgkinson does not show is whether this band has any fine-scale structure (absorption lines).

Hodgkinson shows a very low resolution scan of the C<sub>2</sub>H<sub>6</sub> band at 3000cm<sup>-1</sup> with very little information as to what the figure represents or how the measurements were made. As a consequence, it is almost impossible to tell whether the absorption feature represents anything new above the Hitran data, and impossible to tell whether the absorption feature contains any new absorption lines.

For the GFCR technique to work, it requires that the gas being measured has fine-scale (spectral) line structure as disclosed in Fig. 3 of the present application. In other words, the individual absorptions lines have to be distinct under typical measurement pressures and temperatures. The GFCR technique uses a sample of the gas of interest as a "spectral filter" to select wavelengths over a wide pass-band where the gas of interest absorbs. In other words, to first order, a GFCR measures the gas of interest only at wavelengths where the gas has an absorption line. This provides two distinct and important advantages. First, by selecting only wavelengths where absorption of the gas is located, sensitivity to that gas is significantly increased. Second, by selecting only wavelengths where the gas of interest absorbs, it reduces the interference of other gases which may have absorption lines in the same spectral region. Since most of the absorption lines of the interfering gases will not overlap the lines of the gas of interest, sensitivity to interference by other gases is minimized.

If a GFCR is used to detect a gas in which the absorption band does not contain any fine structure (as is shown in Hodgkinson), the GFCR will have very little selectivity for the gas of interest. Any interfering gases (gases with absorption lines within the band, such as water) will interfere substantially with the measurement, producing erroneous signals. For ethane, it is not immediately clear that fine-structure in the band should exist, and Hodgkinson's data does not suggest it does. All that can be said from the Hodgkinson patent is that there seems to be a larger than expected broad absorption feature in ethane at 3.35  $\mu$ m from a spectral measurement of an unknown spectral resolution of an unknown quantity of ethane. This figure does little to suggest that this absorption feature might make a good spectral band for measuring C<sub>2</sub>H<sub>6</sub> with a GFCR.

Consequently, for at least the above reasons, it is submitted that claim 3 is patentable over the cited references.

#### Patentability of Claim 4

Claims 4 and 9 of the present application are rejected under 35 U.S.C. § 103(a) as being unpatentable over Nelson (and presumably Sachse, although this is not recited in the Office Action) in view of what is alleged to be old or well known. Applicants respectfully traverse this rejection. Claim 9 has canceled, thus rendering its rejection moot.

Claim 4 depends on claim 1, which is distinguished over Nelson by the recitation of detecting the presence of ethane by detecting variations in solar radiation reflected from the target area, and over Sachse due to simultaneous measurement of the radiation in the two optical paths. In addition, the following arguments apply.

If this rejection is based on Hodgkinson, that rejection is dealt with by the argument presented above in relation to claim 3. If the rejection is based on the allegation that "any specific band would have been an obvious design choice," that is incorrect. Various factors dealt with above in relation to the Hodgkinson reference make the selection of the band more than an exercise of routine skill. A specific absorption peak of a target gas must provide adequate absorption bands, as well as not include interfering bands of other absorbers, and provide a sufficiently strong signal over background that the signal is detectable.

#### Patentability of Claims 6, 10, 18, 20, 24, 25, and 33

Claims 6, 10, 14, 18, 20, 24, and 25 of the present application were rejected under 35 U.S.C. § 103(a) as being unpatentable over Nelson and Sachse in view of Jeon. Applicants respectfully traverse this rejection. Claim 14 has been canceled, thus rendering its rejection moot. Claim 10 depends on claim 6. Claims 20, 24, and 25 depend on claim 18. The patentability of claims 6 and 18 is addressed below. The Office Action contains no reference to claim 32, which was not entered. The language of claim 32 has been rewritten as claim 33 and also falls under this heading and will be treated as such since it is dependent on claim 18.

Claim 6 has been amended to require that:

the beam splitter comprises a bi-prism formed of a pair of wedges, each wedge having a thinner side and a thicker side, the pair of wedges being joined along the respective thinner sides and oriented so that radiation on each of the first optical path and the second optical path passes through only a respective one of the wedges.

Claim 18 requires:

a bi-prism beam splitter comprising a pair of side-by-side prisms mounted transversely in the housing in relation to the first optical path and the second optical path as part of the optics for directing radiation entering the window from an outside source along two divergent paths offset from each other by refraction through the bi-prism beam splitter to divide the radiation between the first optical path and the second optical path.

Both claims 6 and 18 distinguish over the beam splitter of Jeon. In Jeon, the beam splitter is formed by a pair of wedges joined together to create a surface from which light is partially reflected. Thus, in Jeon, it is not true that "each of the first optical path and the second optical path passes through only a respective one of the wedges" as claimed in claim 6 nor is it true that in Jeon "a pair of side-by-side prisms [is] mounted transversely in the housing in relation to the first optical path and the second optical path" or that "radiation entering the window from an outside source [is directed] along two divergent paths offset from each other by refraction through the bi-prism beam splitter to divide the radiation between the first optical path and the second optical path," as claimed in claim 18.

In the art, as previously argued and as the Examiner has now recognized by citation of Jeon, it is common to use a partially reflective mirror to achieve separation of light beams. In the claimed bi-prism, however, light is not partitioned using a reflected component nor caused to converge, but instead is partitioned using the transmitted components of two portions of a bi-prism. As shown in Fig. 2 of the present disclosure, the energy passing through the system is partitioned biaxially. Energy passing through each half of the optical chain is imaged offset from each other. The distance between the images is a function of the angle of the prisms. This technique minimizes polarization problems, partly due to the fact that the angles of the prism

surfaces relative to the optical axis are small. Hence, for at least the foregoing reasons, claims 6, 10, 18, 20, 24, 25, and 33 are patentable over the cited art.

Patentability of Claim 17

Claim 17 of the present application was rejected under 35 U.S.C. § 103(a) as being unpatentable over Nelson and Sachse in view of Smith. Applicants respectfully traverse this rejection. Nelson and Sachse are distinguished as indicated above and Smith does not disclose the teachings that are missing from Nelson and Sachse. Therefore, claim 17 is submitted to be in allowable condition.

Patentability of Claims 21-23

Claims 21-23 of the present application were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Nelson in view of Butler, Sachse, or Smith in view of Jeon and Hodgkinson. Applicants respectfully traverse this rejection for at least the reasons given in relation to claim 3 (Hodgkinson is not relevant).

CONCLUSION

In view of the foregoing amendments and arguments, applicants submit that Claims 1-4, 6, 10, 15-18, 20-25, and 33 are in condition for allowance. Action to that end is respectfully requested.

Respectfully submitted,

CHRISTENSEN O'CONNOR  
JOHNSON KINDNESS<sup>PLLC</sup>



Kevan L. Morgan  
Registration No. 42,015  
Direct Dial No. 206.695.1712

KLM:sjt